Advanced Command Destruct System (ACDS) Enhanced Flight Termination System (EFTS)

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1999 Global Hawk Video

From AFFTC

Agenda

- **Program Overview / Background**
- **Air Force Flight Test Center (AFFTC) / NASA Dryden Flight Research Center (DFRC) Integration**
  - AFFTC / NASA DFRC Current Operating Capability (COC)
  - Current Operational Usage
  - Future Operating Capability (FOC) - ACDS - AFFTC and DFRC Combined Implementation Efforts
- **Questions**

Program Background

Program Background

- **Current flight termination system (FTS) operates in UHF frequency band (420 – 450 MHz)**
- **2 Major Common Types of FTS**
  - Standard analog system (Uses three tones in a simple logic sequence to initiate termination, similar to FM radio)
  - High alphabet system (Uses combination of an eleven character, frequency modulated, tone pattern)
    - Secure but not encrypted
- **EFTS initiated and propelled because of key events**
  - Global Hawk inadvertent termination in Mar 1999
    - AF/CV and AFMC/CC tasking based on findings
    - Investigate encryption of command destruct links
  - NASA Inspector General assessment letter in Aug 1999 and subsequent recommendation letter in Aug 2000
    - Explore low-cost, lightweight space Communications Security (COMSEC) for FTS
  - Strategic Target System inadvertent termination in Nov 2001

Program Background (cont.)

- **Range Commanders Council (RCC) Range Safety Group (RSG) study task, initiated in Apr 2000 and completed in Apr 2002, to select and document a robust, affordable, reliable technology that provides an encrypted FTS capability**
  - EFTS Program team formed (Air Force, NASA, RSG, Telemetry Group, Telecommunications & timing Group, Academia, NSA, Industry)
  - Continuous Phase Frequency Shift Keying (CPFSK) aka PCM/FM selected as modulation
  - Triple Data Encryption Standard (TDES) selected for security
  - Digital message format
  - Forward Error Correction (FEC) to protect against interference
- **Prototype phase, initiated in May 2002 and completed in Jan 2004, to validate proposed technology for range safety application**
  - Prototype flight termination receivers and ground-based addressable Encoder for command transmitter developed by L-3 Cincinnati Electronics (L-3 CE)
  - Functionality validated on F-15B testbed aircraft at Edwards Air Force Base (AFB)

Program Background (cont.)

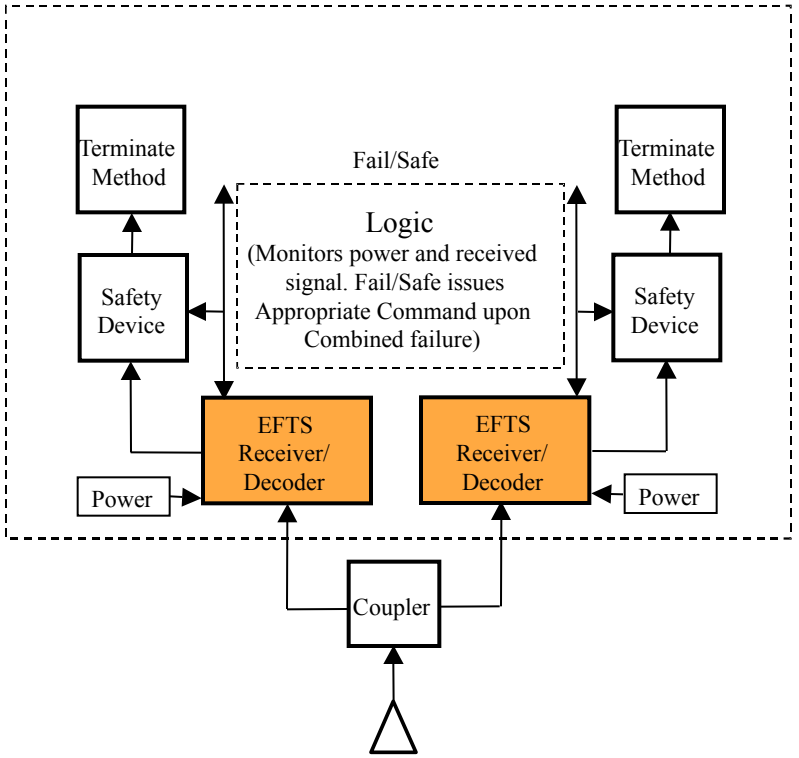
- **Development of EFTS receiver and ground systems, initiated in Jan 2004 and completed in Apr 2007**
  - Receiver contracts awarded August 2004 to L-3 CE to develop equipment that meet environmental requirements for Missile, Unmanned Aerial Vehicle, and Space-Launch applications
  - Ground Systems contract awarded August 2005 to L-3 CE for development of ground system equipment (encoder, monitor, and Triple DES Unit)
- **Testing**
  - Acceptance and qualification testing on flight termination receiver initiated in Oct 2005 and completed Apr 2007
    - Qualification test report accepted Aug 2007
  - Acceptance testing on ground equipment initiated in Dec 2005 and completed in Nov 2006
  - Demonstrated the system's capabilities on an Advanced Medium Range Air-to-Air Missile (AMRAAM) at Eglin/Tyndall AFB

AFFTC / NASA DFRC Integration

NASA DFRC EFTS Background

- Current Operating Capability (COC) - NASA DFRC started working towards single vehicle EFTS system Jan 2008
- Future Operating Capability (FOC) - NASA DFRC and Air Force Flight Test Center (AFFTC) combined effort working towards multiple vehicle and multiple missions simultaneously – effort to be completed by Dec 2011, including full integration and system testing at NASA DFRC
- Current Users – Global Observer, Blended Wing Body, Phantom Ray – all unmanned aerial vehicles (UAVs)

EFTS
Conceptual Drawing



EFTS COC Hardware

Range Safety Officer Command Panel

Local Command Panel

Command Controller

EFTS – L-3 CE Hardware

Enhanced Flight Termination Receivers (FTR)

Encoders

Triple DES Units (TDU)

Monitors

Current Operating Capability

- Developed to support one vehicle per mission
- Developed to support one frequency per mission
- Supports UAVs at NASA DFRC and AFFTC
- Started development in Jan 2008
- Completed 95% of design and hardware builds by May 2008
- NASA DFRC software and system safety acceptance – May 2008 to Feb 2010
- COC accepted as “Operational” ready by NASA DFRC and AFFTC – Mar 2010

COC Approval

- **Independent Review Team**
  - Reviewed all design processes
  - Ensured software safety requirements met
  - Reviewed 100% of software critical code
  - Reviewed and partook in system testing
- **Center Chief Engineer Review Board**

COC Testing

- **Component level testing**
  - Fully tested each individual command path component
  - Exercised every possible error mode that could be thought of
  - Exercised every known and expected function
  - Followed test procedures
  - Recorded data – electronically and manually
- **System level testing**
  - End to end testing – open loop and closed loop

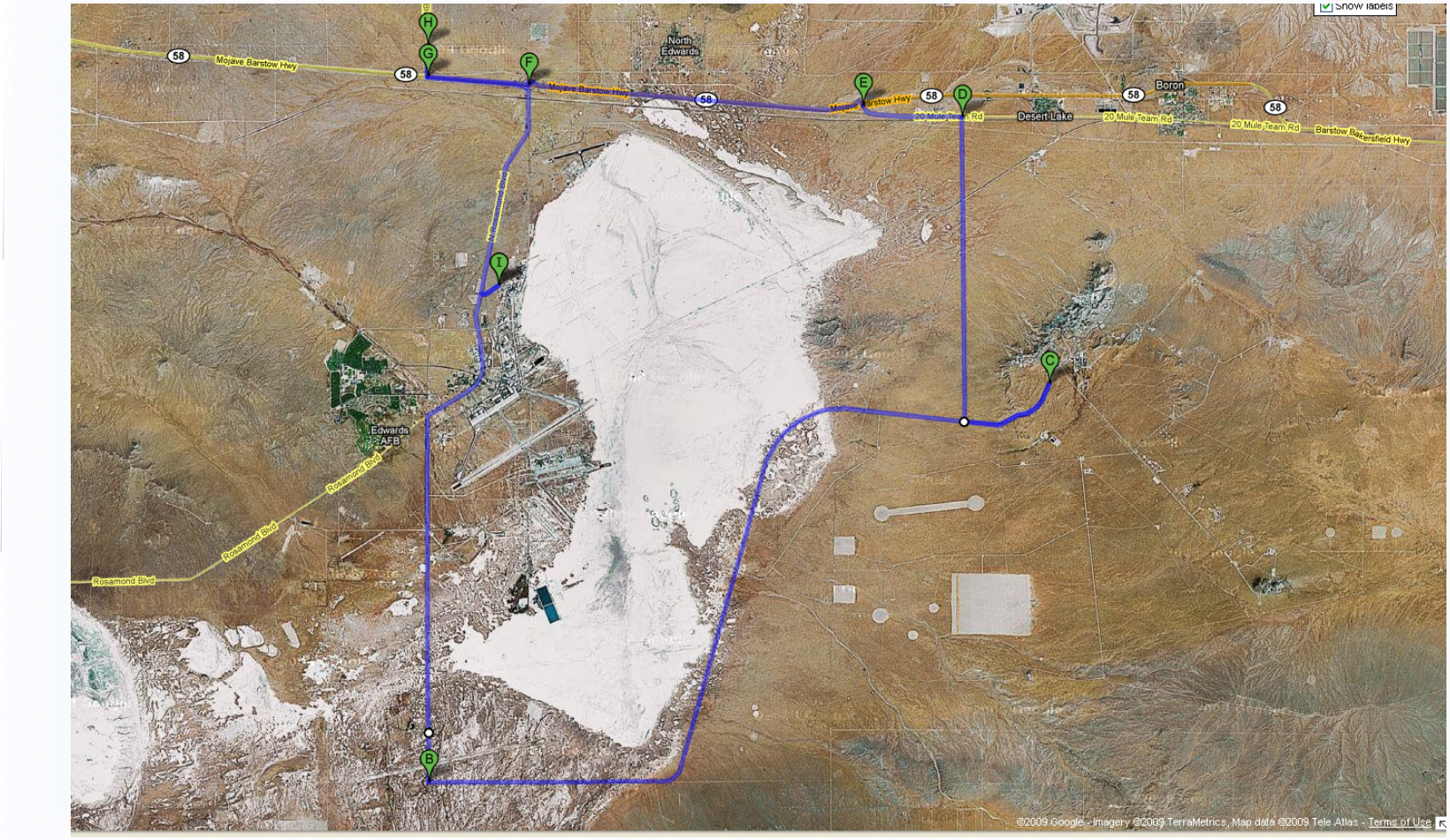
COC Testing cont.

- **Full end-to-end system testing completed**
  - Included exercising of Range Safety Officer (RSO) command panel through entire FTS network; transmitted out and fed into monitoring device to verify properly transmitted FTS commands
    - Viewed EFTS command signal response via the EFTS FTR and EFTS Monitor

COC Testing cont.

- **Component Testing**
  - Duration Testing – 48 hours
- **Full End-to-End System Testing**
  - Duration Testing – 48 hours
- **Location Testing – Two Drives Tests on Base**
  - Around Edwards Air Force Base (EAFB) – 6/18/2009
  - On the EAFB Flightline – 7/1/2009
- **Acceptance Testing Completed – 8/26/2009**

COC Testing Locations
(Google Map Image)



Current Operational Usage

- **Three projects using EFTS operationally:**
  - Global Observer (GO)
  - X-48 / Blended Wing Body (BWB)
  - Phantom Ray
- **One project anticipated by end FY2011:**
  - Phantom Eye
- **GO – successfully flew first flight with EFTS active on 7/9/2010 – first EFTS flight with production EFTS equipment**
- **X-48 – successfully flew with EFTS active**

Current Operational Usage

- **Full development of recertification process for EFTS FTRs**
  - Recertification process coordinated with the RCC
  - Assisted RCC to develop the EFTS FTR testing requirements
- **Successful recertification of nine EFTS FTRs**
- **About 80 successful operations with EFTS to date**
  - 40 ground tests
  - 40 flight tests
- **Zero failures of EFTS system, to date, in support of EFTS operations**
- **Zero mission impacts due to EFTS system failures, to date**

Fox News Video

Article Title: New Generation of Military Gadgets Coming, From Large Spy Systems to Tiny Drones

Original URL: http://www.foxnews.com/scitech/2011/03/01/military-pour-millions-unmanned-aircrafts/#content

Future Operating Capability

- **Advanced Command Destruct System**
  - Request for proposal for full integration – won by WV Communications in Feb 2010
  - Supports NASA DFRC and AFFTC FTS missions
  - Developed to support five vehicles per mission
  - Developed to support two simultaneously missions
- **FOC development work and requirements based upon the work done on the COC**
- **Expected operational at end CY2011**

Questions??


NASA